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BROWNS LAKE, RACINE COUNTY, WISCONSIN

Pacific Northwest Environmental Research Laboratory

Prepared for:

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Wisconsin Department of Natural Resources
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June 1975

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NATIONAL EUTROPHICATION SURVEY

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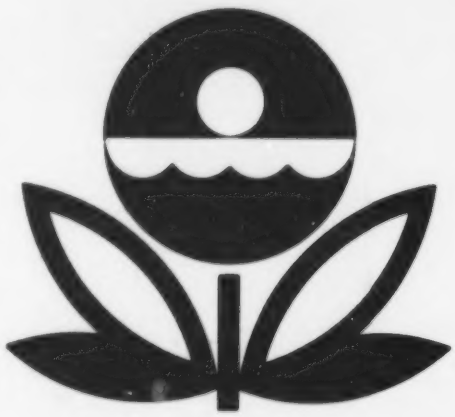

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT

ON

BROWNS LAKE

RACINE COUNTY

WISCONSIN

EPA REGION V

WORKING PAPER No. 67

WITH THE COOPERATION OF THE

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

AND THE

WISCONSIN NATIONAL GUARD

JUNE, 1975

CONTENTS

	Page
Foreword	ii
List of Wisconsin Study Lakes	iv, v
Lake and Drainage Area Map	vi
Sections	
I. Introduction	1
II. Conclusions	1
III. Lake Characteristics	2
IV. Lake Water Quality Summary	3
V. Literature Reviewed	8
VI. Appendix	9

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS*

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

* The lake discussed in this report was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. Tributaries were not sampled, and this report relates only to the data obtained from lake sampling.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conducting the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano
Sinnissippi	Dodge

LAKE NAME	COUNTY
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett

FOX RIVER
4242
BROWNS
LAKE
01X
Cedar
Park
4241
Fischer
Park
outlet
Rockland
Lake
Camp
Maclean
Hoosier
Creek
WIS.
Map Location
BROWNS LAKE
X Lake Sampling Site
Urban Area
0
1/4
1/2Mi.
Scale
8815
8814
4240

BROWNS LAKE

STORET NO. 5560

I. INTRODUCTION

Browns Lake was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. No tributaries were sampled, and no wastewater treatment plants impact the lake (McKersie, et al., 1972). Therefore, this report only relates to lake sampling data.

II. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Browns Lake is eutrophic. Of the 46 Wisconsin lakes sampled, nine had less and one the same mean total phosphorus, 11 had less and one the same mean dissolved phosphorus, 12 had less mean inorganic nitrogen, 12 had less mean chlorophyll *a*, and 12 had greater mean Secchi disc transparency. Some depression of dissolved oxygen occurred at nine feet in August, 1972.

Weeds are reported to be a major use-problem (Poff and Threinen, 1961), and the lake has been treated chemically to control aquatic plants (Lueschow, 1972).

B. Rate-Limiting Nutrient:

The results of the algal assay show that Browns Lake was phosphorus limited at the time the sample was taken (11/10/72). The lake data indicate nitrogen limitation in June and August.

III. LAKE CHARACTERISTICS

A. Morphometry*:

1. Surface area: 396 acres.
2. Mean depth: 7.9 feet.
3. Maximum depth: 44 feet.
4. Volume: 3,135 acre-feet.

B. Precipitation**:

1. Year of sampling: 38.7 inches.
2. Mean annual: 31.5 inches.

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* Ball, 1973.
** See Working Paper No. 1, "Survey Methods, 1972".

IV. LAKE WATER QUALITY SUMMARY

Browns Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from one or more depths at a single station on the lake (see map, page vi). During each visit, a single depth-integrated (near bottom to surface) sample was collected for phytoplankton identification and enumeration, and a similar sample was collected for chlorophyll a analysis. During the last visit, a single five-gallon depth-integrated sample was taken for algal assays. The maximum depth sampled was 9 feet.

The results obtained are presented in full in Appendix A, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix A.

A. Physical and chemical characteristics:

FALL VALUES

(11/10/72)

Parameter	Minimum	Mean	Median	Maximum
Temperature (Cent.)	7.0	7.0	7.0	7.0
Dissolved oxygen (mg/l)	8.8	9.1	9.1	9.5
Conductivity (μmhos)	480	490	490	500
pH (units)	7.9	7.9	7.9	7.9
Alkalinity (mg/l)	153	154	154	154
Total P (mg/l)	0.019	0.021	0.022	0.022
Dissolved P (mg/l)	0.012	0.013	0.012	0.014
NO_2 + NO_3 (mg/l)	0.130	0.137	0.140	0.140
Ammonia (mg/l)	0.200	0.207	0.210	0.210

ALL VALUES

Secchi disc (inches)	10	79	84	144

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/21/72	1. Chlamydomonas	5,063
	2. Schroederia	253
	3. Dinobryon	211
	4. Chroococcus	175
	5. Cryptomonas	151
	Other genera	54
	Total	5,907
08/16/72	1. Aphanocapsa	642
	2. Cocconeis	344
	3. Dinobryon	289
	4. Navicula	271
	5. Nitzschia	244
	Other genera	859
	Total	2,649
11/10/72	1. Dinobryon	609
	2. Flagellates	464
	3. Melosira	398
	4. Achnanthes	24
	5. Anabaena	6
	Other genera	30
	Total	1,531

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/21/72	01	12.0
08/16/72	01	5.1
11/10/72	01	2.1

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.005	0.778	0.8
0.006 P	0.011	0.778	2.9
0.012 P	0.017	0.778	4.7
0.024 P	0.029	0.778	7.2
0.060 P	0.065	0.778	7.4
0.060 P + 10.0 N	0.065	10.778	23.1
10.0 N	0.005	10.778	0.4

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Browns Lake was moderate at the time the sample was taken (11/10/72). Also the increased yields with increased levels of orthophosphorus indicate the lake was phosphorus limited at that time (note the lack of yield response when only nitrogen was added).

The lake data confirm phosphorus limitation in November (N/P ratio = 26/1) but indicate nitrogen limitation in June (N/P = 4/1) and August (N/P = 10/1).

V. LITERATURE REVIEWED

Ball, Joseph R., 1973. Personal communication (lake morphometry). WI Dept. Nat. Resources, Madison.

Lueschow, Lloyd A., 1972. Biology and control of aquatic nuisances in recreational waters. Tech. Bull. 57, WI Dept. Nat. Resources, Madison.

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Poff, Ronald J., and C. W. Threinen, 1961. Surface water resources of Racine County. WI Cons. Dept., Madison.

VI. Appendix

APPENDIX A

Physical and Chemical Data

STORET RETRIEVAL DATE 74/09/30

556001
42 41 00.0 088 14 30.0
BROWNS LAKE
55 WISCONSIN

11EPALES 2111202
5 0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/21	17 00	0000	17.9	9.6	10	345	9.40	119	0.040	0.040	0.022	0.018
72/08/16	08 40	0000	23.5		84	418	8.70	131	0.080	0.100	0.021	0.015
	08 40	0004	23.2	8.4		405	8.85	122	0.060	0.060	0.020	0.011
	08 40	0009	22.1	6.6		405	8.85	122	0.070	0.060	0.022	0.020
72/11/10	12 25	0000			144	500	7.90	154	0.140	0.210	0.022	0.012
	12 25	0004	7.0	8.8		490	7.90	153	0.140	0.200	0.022	0.014
	12 25	0008	7.0	9.5		480	7.90	154	0.130	0.210	0.019	0.012

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/21	17 00	0000	12.0J
72/08/16	08 40	0000	5.1J
72/11/10	12 25	0000	2.1J

J VALUE KNOWN TO BE IN ERROR